

Challenges in Visualizing Knowledge and Metadata

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Unique Challenges in Knowledge Engineering

- Scale

- Size of individual ontologies

- On the Semantic Web - Size of the entire RDF graph when external concepts are linked in

- Interconnectedness

- Usually no simple hierarchy or strongly disjointed graphs

Some Existing Systems

- GraphViz

- Based on ISAViz

- Used to generate graphs in the RDF Validator

- Protégé

- Jambalaya

- TGVizTab

Two Fronts of Visualization

- Large Graphs

- Understand structural properties of the data

- Hierarchies

- Using the hierarchy as a base, display well organized semantic graphs

Graphs

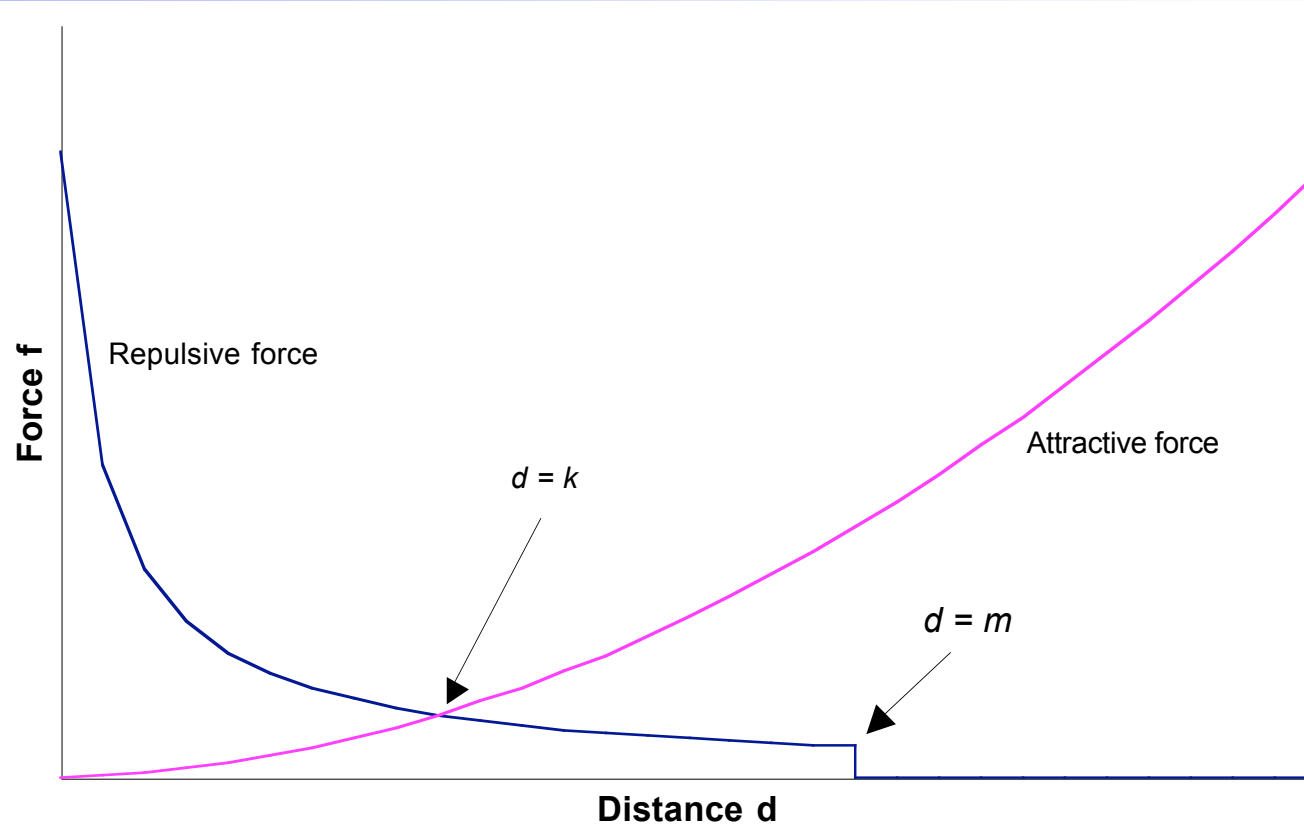
Visualizing the Semantic Web

- When looking at an ontology, its structure is not apparent from the text.
- Current visualization tools do not layout the graph with the goal of understanding the underlying structure

Graph Layout

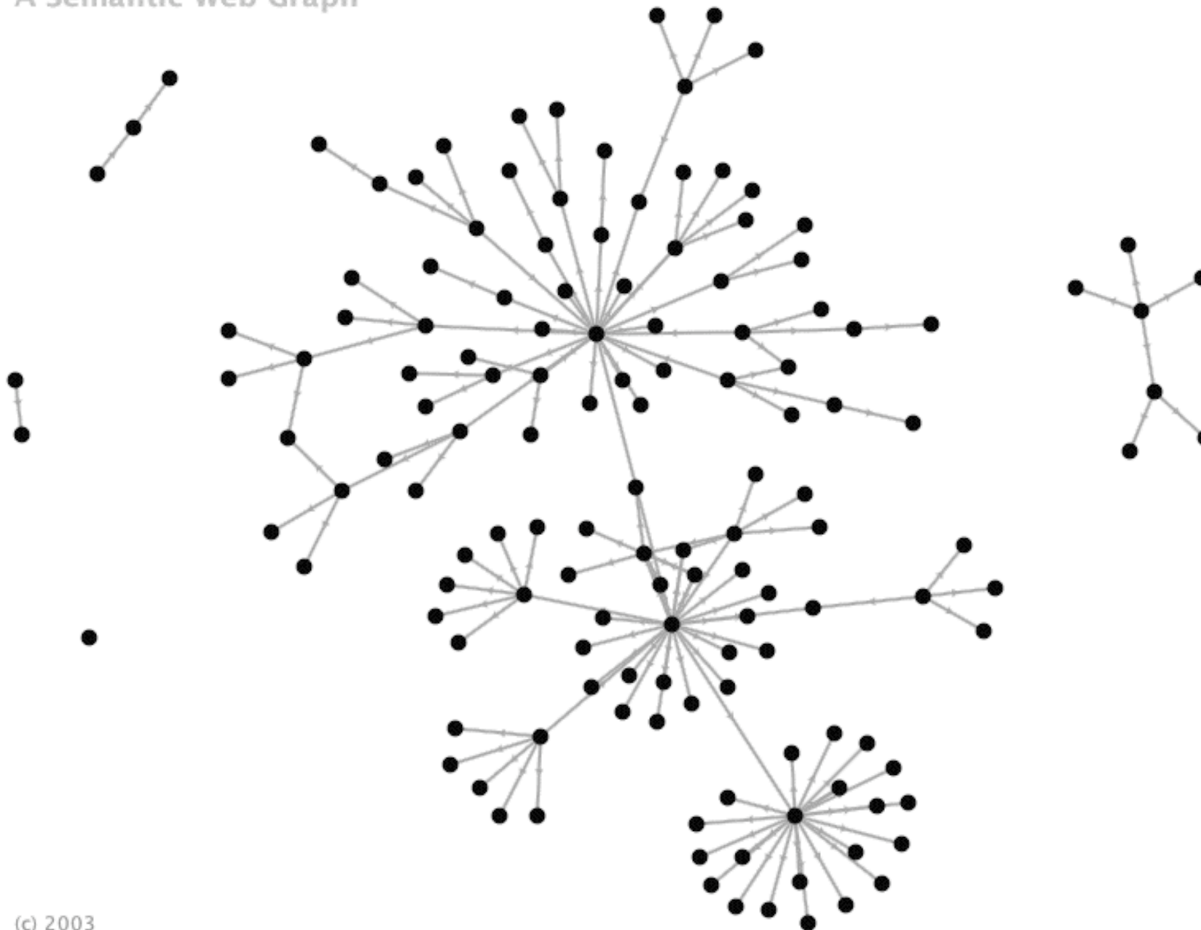
- We use a modified Spring Embedder to embed the graph's nodes in the plane
- Edges cause attractive forces between nodes
- All pairs of nodes exert a repulsive force
- The range of this repulsive force is limited, so we are able to draw disconnected graphs
- Method iterates until an equilibrium is reached

m-limited force model



Effect of m-limited force model

A Semantic Web Graph



(c) 2003

Scalability for each iteration

- Classical spring embedder is $O(N^2)$
- Effective optimised versions are $O(N \log N)$
 - Could allow tens of thousands of nodes to be embedded within a reasonable amount of time
- Some optimisations claim $O(N)$
 - Only effective for certain types of graph
- Larger graphs require more iterations

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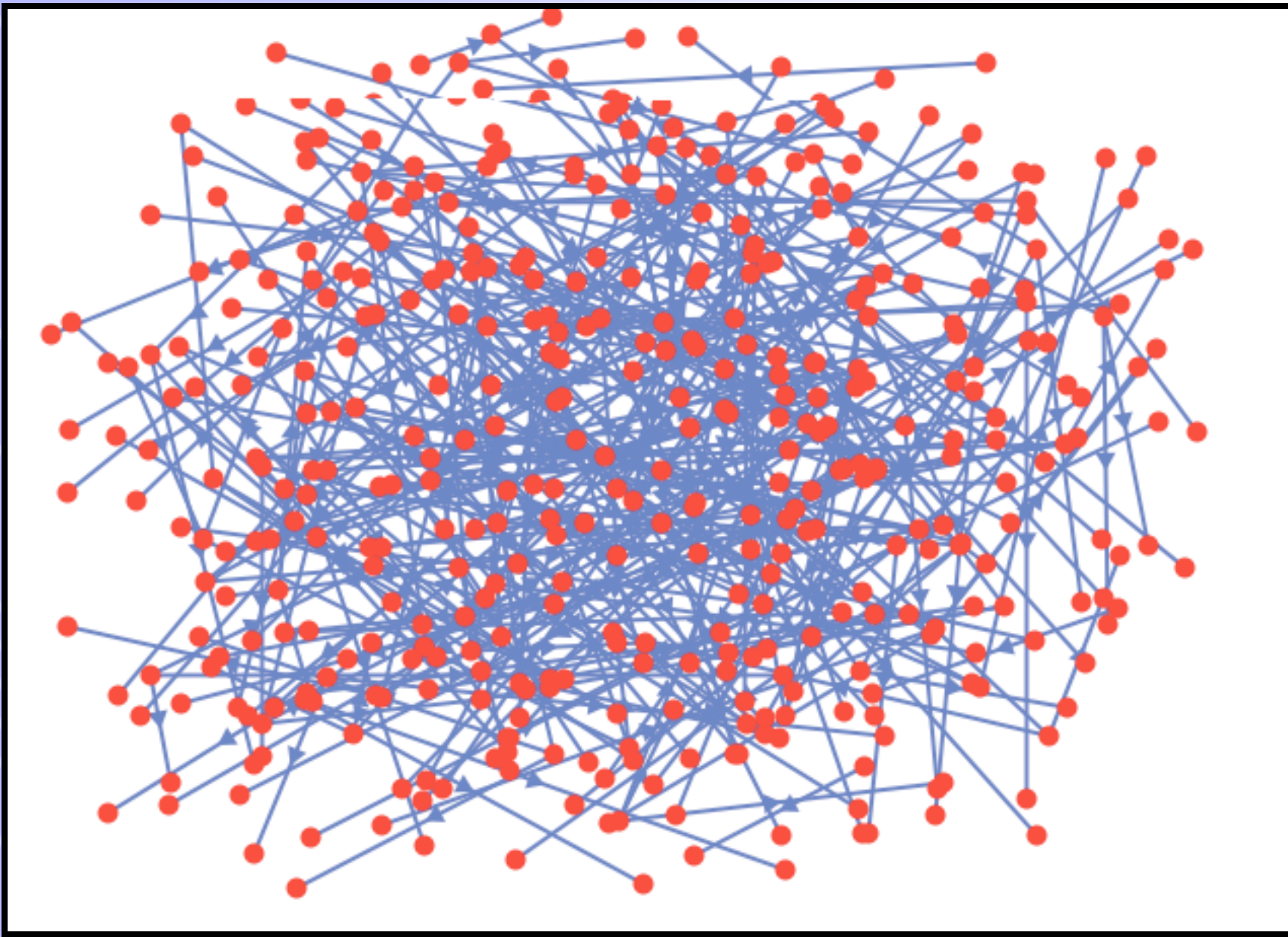
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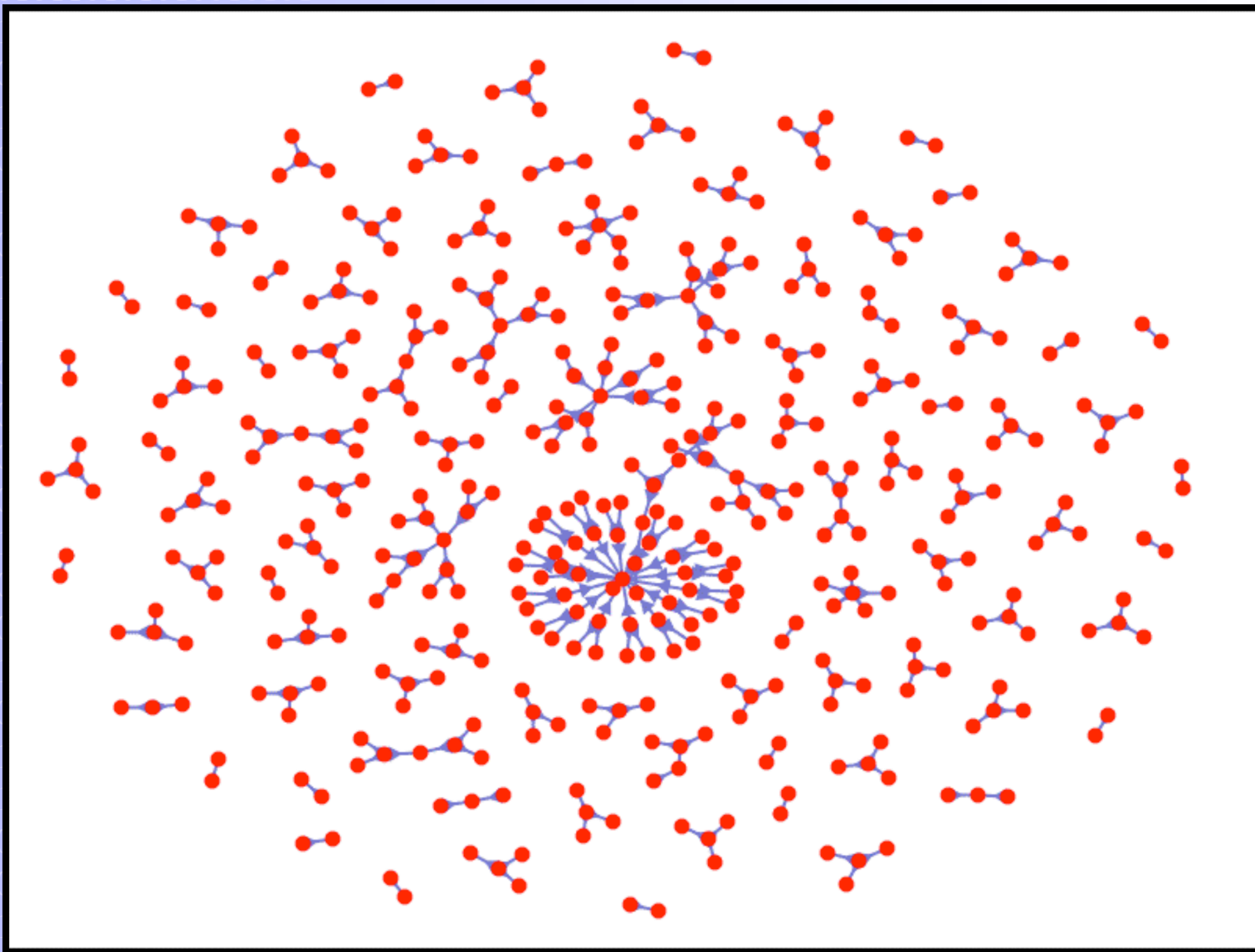
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Currency

- Three letter currency codes as defined by ISO 4217.
- Visualization shows that, as expected from the ontology, most items are individual currencies and their data. However, visualization also shows centralized collection of terms

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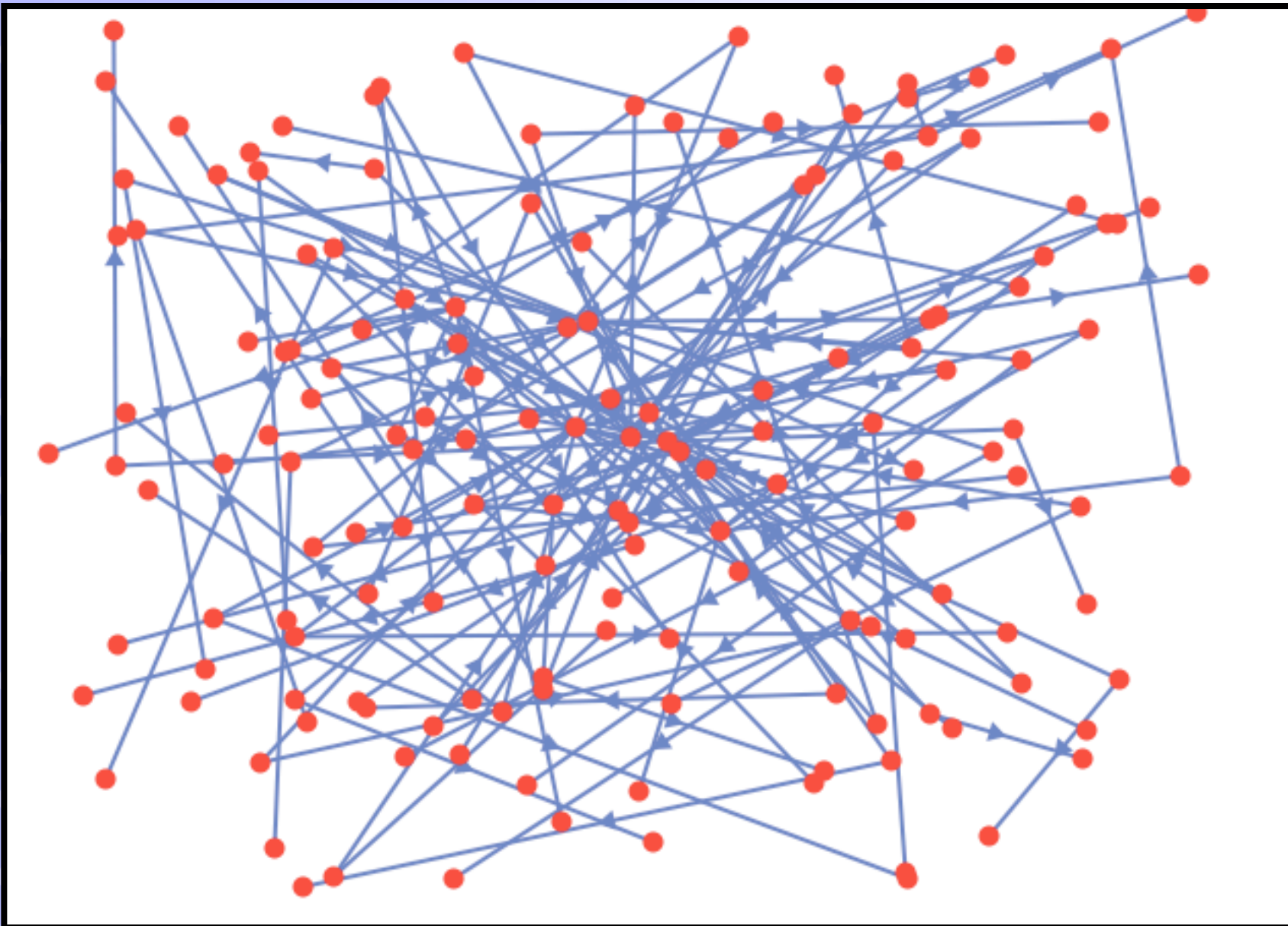
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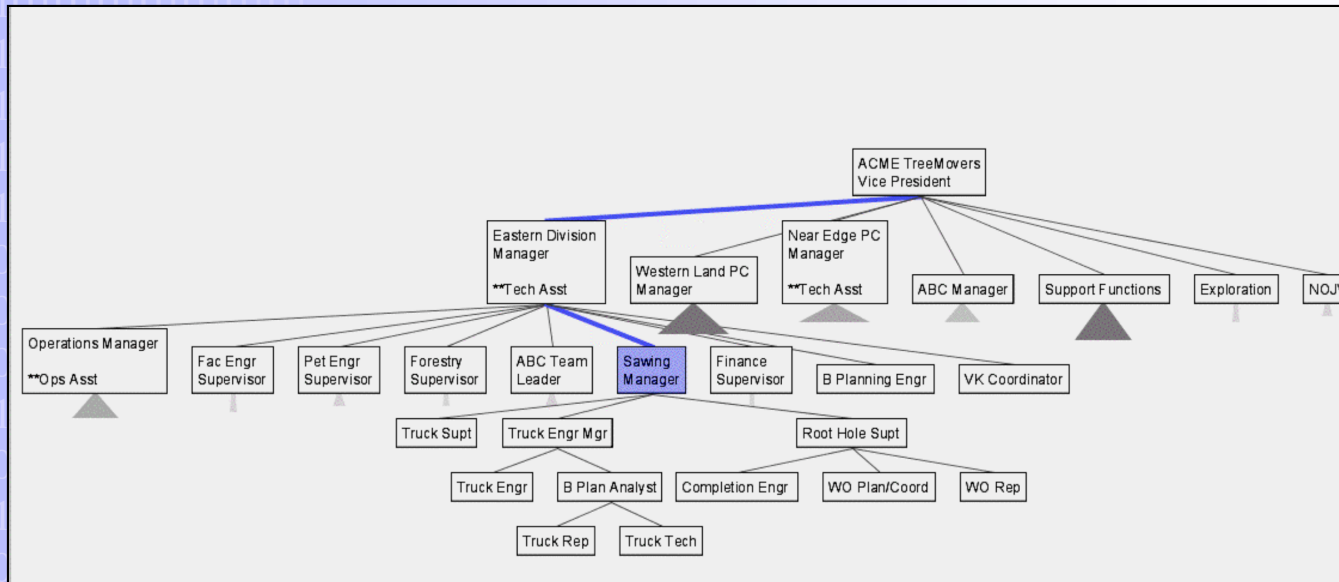
Space Shuttle

- Ontology describes the Shuttle's System and parts
- Visualization shows connection between shuttle parts and functions

Hierarchies

Space Tree

- Node-link tree design
- Dynamic Rescaling
- Zooming



Taxon Tree

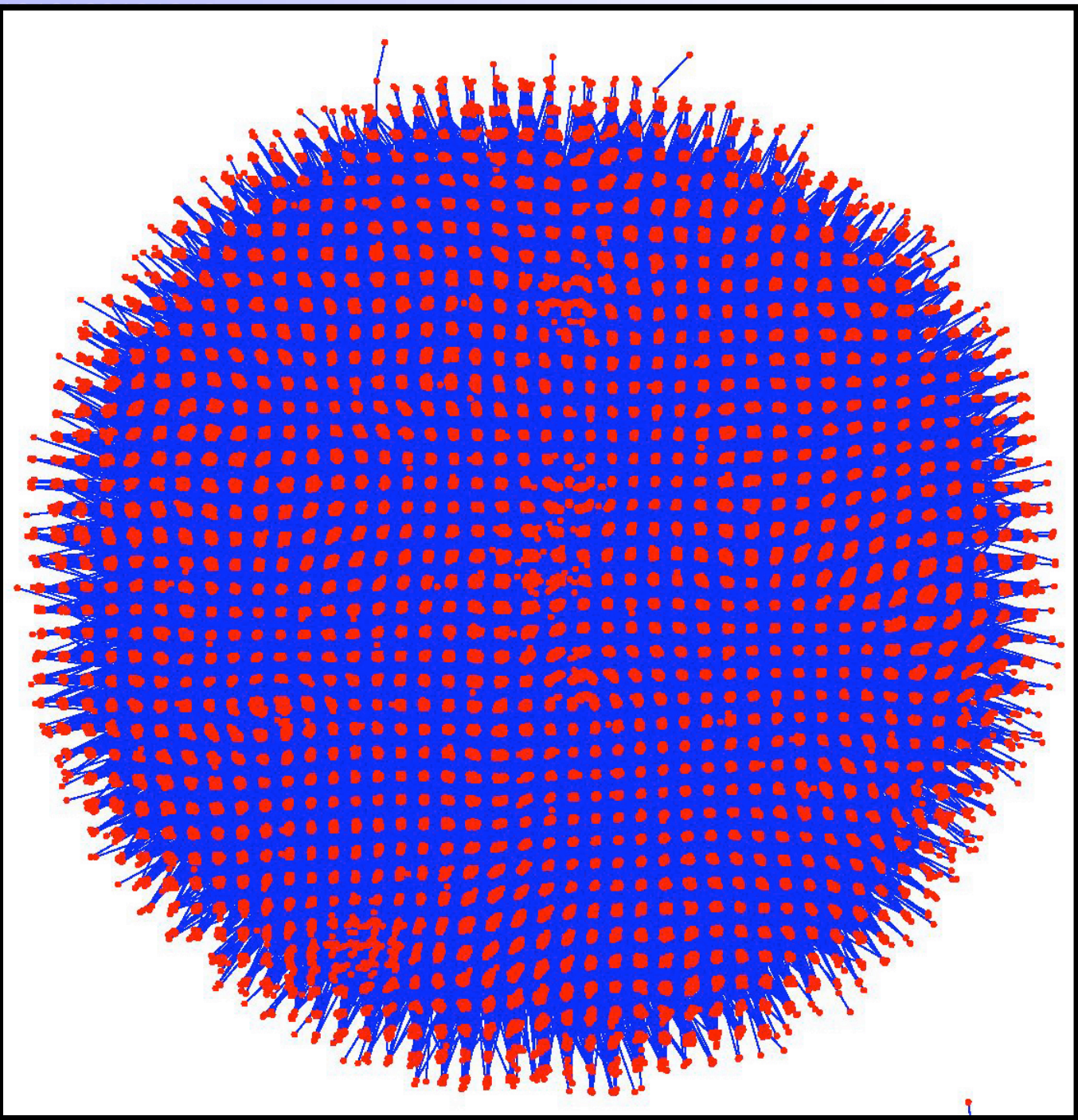
- Designed to show hierarchy of animal taxonomy
- SpaceTree layout combined with dynamic queries
- <http://www.cs.umd.edu/hcil>

Challenge

Challenge for Visualization Tools

- National Cancer Institute Ontology
 - Golbeck, Jennifer, Gilberto Fragoso, Frank Hartel, Jim Hendler, Bijan Parsia, Jim Oberthaler, " The National Cancer Institute's Thesaurus and Ontology," to appear in the *Journal of Web Semantics*, vol 1 (1).
 - <http://www.mindswap.org/2003/CancerOntology>
- 17,000 classes
- ~500,000 triples
- 32MB

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